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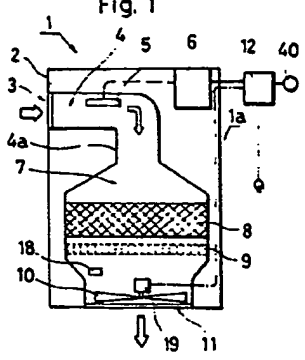
(54) Method and apparatus for deodorizing toilet room.

(57) According to the present invention there is provided a toilet room deodorizing method wherein an offensive odor emitted from excrements in a toilet bowl is introduced directly into a deodorizing apparatus (1) at a predetermined air volume, then is mixed with a predetermined concentration of ozone and passed through a catalyst bed (8) for efficient deodorizing treatment, thereby preventing the offensive odor from being diffused into the toilet room and permitting this deodorizing treatment stably over a long period, as well as a toilet room deodorizing apparatus (1) wherein an ozone generator (5), a catalyst bed (8) and a fan (10) are provided within an air passage (4), whereby offensive odor components in a toilet bowl can be introduced for deodorization into the said air passage (4) within a predetermined time, and the entire apparatus can be constructed compactly and disposed in a toilet room without causing any inconvenience.

Fig. 1



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Method and Apparatus for Deodorizing Toilet Room

The present invention relates to deodorizing method and apparatus capable of surely removing an offensive odor from excrements in a toilet bowl before diffusion thereof into the toilet room and capable of maintaining the deodorizing performance over a long term.

The following methods may be mentioned as the most orthodox means for removing the offensive odor in a toilet room: ① a method wherein an exhaust fan is attached, for example, to the wall surface of the toilet room to discharge the inside offensive odor to the exterior, and ② a method wherein an aromatic is placed in the toilet room to mask the offensive odor by a strong fragrance.

In the above methods ① and ②, however, the offensive odor is not removed thoroughly. In the above method ①, the offensive odor once diffused and filled in the toilet room from the toilet bowl is discharged to the exterior of the toilet room, so the person in the toilet room is inevitably exposed to the offensive odor. Besides, since the offensive odor is discharged out of the toilet room, there occurs inconvenience in an area where houses stand close together. In the above method ②, no essential countermeasure is taken to destroy the offensive odor itself, but the offensive odor is to be veiled under a strong fragrance, so the person in the toilet room may rather feel repugnance to the aromatic and thus the above method ② is not effective to persons who are sharp in the sense of smell. Even the combination of this method with the above method ① gives no solution in that it diffuses the offensive odor to the neighborhood.

As offensive odor components in the excrements from the human body are mentioned ammonia, hydrogen sulfide, methyl mercaptan, trimethylamine and acetaldehyde. As means for destroying these offensive odor components thoroughly there has been adopted, separately from or in a partial combination with the foregoing methods ① and ②, a method which employs an adsorptive deodorizer such as active carbon or silica gel to adsorb and thereby remove the offensive odor components. For example, there has been practised a method wherein an adsorptive deodorizer was placed in a toilet room for the deodorization of the whole of the toilet room. According to this method, however, since the entire capacity of the toilet room is too large, a long time is required until attainment of the deodorizing effect and so this method is ineffective against the strong offensive odor just after an excreting act. In view of this point there has been proposed a method wherein ther is formed an exhaust path which faces the internal space of a toilet bowl and the aforementioned deodorizer is placed in the said exhaust path to conduct the air which contains offensive odor components to the deodorizer, thereby removing the offensive odor components. According to this proposed method, the offensive odor components can be removed directly before diffusion from the toilet bowl into the toilet room, but since the adsorption capacity of the deodorizer has its limit and the deodorizer is exposed to the air continually, it is impossible to maintain a sufficient adsorptive deodorization performance over a long time, thus resulting in that the offensive odor components in the toilet bowl will overflow into the toilet room in a short time after the start of use. To prevent such overflow of the offensive odor components it is necessary to replace the deodorizer with a new one frequently and thus there has been a serious problem in the aspects of economy and management.

It is a primary object of the present invention to eliminate the inconvenient points in the above conventional deodorizing means for a toilet room and provide method and apparatus for deodorizing a toilet room, capable of deodorizing offensive odor components from the excrements in a toilet bowl surely before diffusion thereof into the toilet room to prevent the person in the same room from smelling the offensive odor and further capable of maintaining a stable deodorizing performance over a long period.

It is another object of the present invention to provide method and apparatus for deodorizing a toilet room, capable of effecting a deodorizing treatment efficiently only when required and only for a required length of time because the excrements in a flush toilet are washed out quickly and so the offensive odor components are not continuously diffused into the toilet room.

It is a further object of the present invention to develop a deodorizing apparatus which is compact and easy to use and can be easily attached to a toilet bowl so as not to cause inconvenience in use.

The invention is described in detail in connection with the drawings in which

Fig. 1 is an explanatory view showing an example of construction of a deodorizing apparatus according to the present invention;

Fig. 2 is a plan view showing an example of mounting of the deodorizing apparatus;

Fig. 3 is a partially omitted sectional view taken on line III-III of Fig. 2;

Fig. 4 is a partially cut-away explanatory view showing another example of mounting of the deodorizing apparatus;

Fig. 5 is a sectional view taken on line IV-IV of Fig. 4;

Fig. 6 is an explanatory perspective view showing an example of application of the deodorizing apparatus to another toilet bowl;

Figs. 7 and 8 are partially cut-away explanatory views showing examples of application of the deodorizing apparatus to other toilet bowls;

Fig. 9 is a partially omitted sectional view showing a further example of mounting of the deodorizing apparatus;

Fig. 10 is an explanatory perspective view showing a still further example of mounting of the deodorizing apparatus;

Fig. 11 is a partially cut-away sectional view showing the details of the deodorizing apparatus;

Fig. 12 is a partially cut-away side view showing a still further example of mounting of the deodorizing apparatus;

Fig. 13 is a partially cut-away side view showing an example of sensor arrangement in the deodorizing apparatus;

Fig. 14 is a side view showing another example of sensor arrangement in the deodorizing apparatus;

Fig. 15 is a flowchart showing an example of operation control using a sensor in the deodorizing apparatus; and

Fig. 16 is a block diagram of a control mechanism used in the deodorizing apparatus.

Fig. 1 is a schematic explanatory view showing a typical example of construction of a deodorizing apparatus according to the present invention. The deodorizing apparatus, indicated at 1, is composed of a deodorizing mechanism 1a and a control mechanism 12. The deodorizing mechanism 1a has a casing 2 formed with two openings which are an intake port 3 and an exhaust port 11. The intake port 3 and the exhaust port 11 are communicated with each other by an air passage 4 defined by a wall surface 4a. The wall surface 4a is formed by a material having corrosion resistance to ozone such as, for example, stainless steel, aluminum alloy, or a synthetic resin material, provided the invention is not restricted by the material used. As will be described in detail later, the intake port 3 is disposed so as to face the interior of the toilet bowl, and an ozone generator 5 is disposed in the air passage 4 on the intake port 3 side, the ozone generator 5 being connected electrically to a transformer 6 (as indicated by a chain line). Between the ozone generator 5 and the exhaust portion 11 there are disposed a catalyst bed 8 and a fan 10. Where required, an adsorbent layer 9 constituted by active carbon for example is provided between the catalyst bed 8 and the exhaust port 11.

An example of the ozone generator 5 employs a ceramic plate. A high voltage is applied to the ceramic plate by the transformer 6 to generate ozone from the oxygen in air, which ozone is released to the air passage 4. As the catalyst bed 8 there are used pellets, balls or cells of any of the materials exemplified below.

The catalyst used in the catalyst bed 8 comprises a carrier and a metal and/or a metal oxide supported on the carrier. Examples of such metal and metal oxide include manganese, iron, nickel, cobalt, silver, platinum, palladium, rhodium, chrominum, molybdenum, lead, tungsten, copper, vanadium, and oxides thereof. These are used each alone or as a mixture. As examples of the carrier there are mentioned alumina, silica, alumina-silica, bentonite, diatomaceous earth, silicon carbide, titania, zirconia, magnesia, cordierite, mullite, and active carbon. More preferred examples are a binary compound oxide comprising titanium and silicon, a binary compound oxide comprising titanium and zirconium,and a ternary compound oxide comprising titanium, silicon and zirconium.

The fan 10 is connected for rotation to an electric motor 19, whereby an air flow (indicated by a white arrow) moving from the intake port 3 side to the exhaust port 11 side is formed in the air passage 4. The position of the fan 10 is not limited to that illustrated in the figure; the fan 10 may be disposed in any position if only the position is within the air passage 4. It is also possible to provide a plurality of fans on both the intake port 3 side and the exhaust port 11 side. Between the ozone generator 5 and the catalyst bed 8 there is formed a mixing chamber 7 for mixing the offensive odor components with ozone. If a fan of low-speed rotation is provided in this position, the effect of agitation will be improved, whereby the offensive odor components decomposing effect can be improved. It is recommended, if necessary, to dispose an ozone concentration sensor 18 in an inside position before the exhaust port 11 to make control so that undecomposed ozone may not be discharged at a high concentration to the exterior of the apparatus.

The deodorizing action of the deodorizing apparatus 1 is as follows.

The air inside the toilet bowl, containing such offensive odor components as ammonia and hydrogen sulfide, is conducted into the air passage 4 through the intake port 3 by a current of air formed by the fan 10, and is mixed in the mixing chamber 7 with the ozone from the ozone generator 5.

The offensive odor components introduced into the catalyst bed 8 together with ozone are oxidized and decomposed into odorless components, which are discharged from the exhaust port 11 into the toilet room. At this time, the surplus ozone which

did not decompose itself without reaction with the offensive odor components is converted back to oxygen in the catalyst bed 8, so there is no fear of leakage of a highly concentrated ozone to the exterior of the apparatus. As long as the concentration of the ozone discharged from the deodorizing apparatus 1 is not higher than 10^{-6} %, it will not give unpleasant feeling to the person in the toilet room, but will give a refreshing feeling to him or her. Therefore, it is recommended to use the ozone concentration sensor 18 to control the amount of ozone to be generated from the ozone generator. Moreover, it is well known that ozone has a sterilizing activity, so the saprophytes (e.g. cocci, actinomycetes, virus) contained in the air from the intake port 3 are sterilized in the deodorizing mechanism 1a, and the saprophytes present in the air in the toilet room are also sterilized by the ozone released in a very small amount from the exhaust port 11.

On the other hand, the control mechanism 12 shown in Fig. 1 is for controlling ON-OFF operation of the deodorizing mechanism 1a. In the deodorizing treatment, the control mechanism 12 causes the transformer 6 and the fan 10 to operate, so that ozone is generated in the ozone generator 5 and a current of air is formed by the fan 10, whereby the deodorizing mechanism 1a is substantially operated to remove the offensive odor components. To the control mechanism 12 are connected the ozone concentration sensor 18 and later-described sensor 40, 40a, if necessary.

In order to remove the offensive odor components in the toilet bowl efficiently using the deodorizing apparatus 1 constructed as above, the intake port 3 of the deodorizing apparatus 1 is disposed so as to face the inner bowl portion of the toilet bowl indicated at 20, as in later-described examples of mounting of the deodorizing apparatus 1. Then, the offensive odor components from the offensive odor source in the toilet bowl are introduced into the deodorizing mechanism 1a immediately without leakage thereof into the toilet room and treated by the following deodorizing method.

In this deodorizing method, in order to prevent the offensive odor in the toilet bowl from being diffused into the toilet room, it is necessary that the volume of air to be sucked per minute in the deodorizing apparatus be set at 7 to 35 times the internal volume of the toilet bowl. An air volume below 7 times is not desirable because the offensive odor will not sufficiently be sucked into the deodorizing apparatus 1 but be diffused into the toilet room. An air volume exceeding 35 times is not d sirable, either, because it is too sufficient in the sense of sucking the offensive odor into the deodorizing apparatus 1, resulting in increase in the volume of air for deodorization and decrease in the deodorization efficiency, and further becaus a too large volume of sucked air causes the body feeling temperature during use of the toilet room to lower so the person in the same room feels cold.

From the standpoint of deodorization it is necessary that the concentration of ozone generated be set at 0.05 to 2 ppm, preferably 0.1 to 2 ppm. If it is below 0.05 ppm, the effect of deodorization will be deteriorated, while at an ozone concentration exceeding 2 ppm there is no problem in the effect of deodorization, but there arises a waste that surplus ozone must be disposed of, and as the case may be, the surplus ozone is diffused into the toilet room in relation to the catalyst capability.

The catalyst bed 8 preferably has a shape in which the catalyst components exhibit a high decomposability and which exhibits a high adsorbability for the offensive odor components. Also in consideration of pressure loss and dust clogging it is most preferable that the shape of the catalyst be honeycomb. Particularly, a honeycomb shape having 100 to 400 cells per square inch is recommended. The shape of each cell of the honeycomb shape is not specially limited; for example, it may be lattice-like, triangular, hexagonal, or corrugated. For attaining a predetermined adsorbability, a larger specific surface area of the catalyst is better because the amount of the catalyst required becomes smaller resulting in that the apparatus can be reduced in size. It is preferable that the specific surface area of the catalyst be not smaller than 50 m^2/g. If the contact surface area of the catalyst per unit air volume is too small, it is likely that the effect of deodorization will become unsatisfactory, while if it is too large, there is the possibility of increased pressure loss and dust clogging. In view of these points it is preferable that the contact surface area of the catalyst at a unit air volume of 1 m^3/hr be in the range of 0.01 to 0.35 m^2. The catalyst bed forming method is not specially limited. For example, the catalyst bed may be formed by an extrusion method or a forming method involving corrugation of ceramics paper.

The evolution (start) of offensive odor components is after a person sits on the seat and begins excretion. This means that the operation of the deodorizing apparatus 1 may be started simultaneously with sitting of a person on the seat. If the operation of the apparatus is stopped simultaneously with washing out of the offensive odor source or if the duration of the apparatus operation after flushing is too short, the treatment for the offensive odor remaining in the toilet bowl or the treatment for the residual offensive odor adsorbed on the catalyst will be insufficient and there is a fear of leakage of the offensive odor components into the toilet room. Moreover, the diffusion of a small amount of offensive odor components around

the toilet bowl is unavoidable, and the offensive odor components decomposing reaction may proceed slower as will be described later, so it is preferable that the duration of the apparatus operation be not shorter than 1 minute, more preferably not shorter than 3 minutes, after washing out of excrements. On the other hand, a too long during time is disadvantageous because it merely leads to the waste of energy. Preferably, the operation time of the deodorizing apparatus after the use of the toilet room is within 15 minutes.

In the above deodorizing method, as to the deodorizing mechanism in the catalyst bed 8, there still remains an unsolved portion. But, according to the results of various studies, it is presumed that both the offensive odor components sucked into the deodorizing apparatus and the ozone from the ozone generator are adsorbed by the catalyst bed 8 and that on the catalyst the ozone acts so as to attack the offensive odor components to oxidize and decompose the offensive odor. Therefore, when the amount of offensive odor components is larger than that of ozone, even though temporarily, it is necessary that the offensive odor components be adsorbed in the catalyst bed 8 to prevent an undecomposed portion of the offensive odor components from being released to the exterior. Thus, it is quite possible that undecomposed offensive odor components will remain in an adsorbed state in the catalyst bed even after washing out of the offensive odor source. In this case, the adsorbed residual offensive odor components can be removed completely by continuously generating ozone in a larger amount than the amount required for decomposing the undecomposed offensive odor components. For these reasons, the catalyst bed 8 is desired to have not only the function as catalyst but also excellent adsorbability.

The volume of sucked air in the above description is based on the internal volume of such a toilet bowl 20 as shown in Figs. 2 and 10. But, in toilet bowls of the type shown in Figs. 6 and 8, the same sucked air volume range as above is applied on the basis of the internal volume of an adaptor 30 or that of an inner bowl 35 shown in Fig. 7.

Among the offensive odor components exemplified previously, acid components such as acetic and proplonic acids are difficult to be decomposed completely by ozone, and alcohols and aldehydes may be merely oxidized to corresponding acids and not decomposed completely to an odorless degree, resulting in reaching the exhaust port 11 as undecomposed offensive odor components. In this connection, the provision of the adsorbent layer 9 such as an active carbon layer on the downstream side of the catalyst bed 8 permits such undecomposed components to be adsorbed and held therein, thereby preventing the offensive odor components to be discharged as th y are. Furth r, by supplying ozone continuously to the adsorbent layer, it is expected that the decomposition reaction of the offensive odor components will proceed in the same layer. The amount of the undecomposed components reaching the adsorbent layer 9 is small because the ozone treatment has already been performed, and therefore it is not necessary to make frequent replacement of the adsorbent layer 9.

Concrete embodiments of the deodorizing apparatus 1 of the present invention will now be described with reference to Figs. 2 to 16. Fig. 2 shows an example of mounting of the deodorizing apparatus 1 having the internal structure shown in Fig. 1. The deodorizing apparatus 1 is attached to a seat 21 which is mounted on a toilet bowl 20 for opening and closing through hinge pieces 24 and 25. As shown in Fig. 3, on the bottom side of the seat 21 is formed a downward opening portion 29 in a corresponding relation to a cavity portion 23 extending along the entire circumference. At predetermined positions in the circumferential direction of the opening portion 29 there are formed rubber pedestals 26 intermittently to form air flowing gaps between the bottom of the seat 21 and the top of the toilet bowl 20. The cavity portion 23 is in communication with the intake port 3 of the deodorizing apparatus 1, which apparatus is fixedly attached to a side edge part of the seat 21.

Under the above construction, when the deodorizing apparatus 1 is in operation, the air containing offensive odor components in the toilet bowl 20 flows in the arrowed direction and is sucked into the deodorizing apparatus 1 successively through the toilet bowl 20, opening portion 29, cavity portion 23 and intake port 3, where it is deodorized.

Fig. 4 shows another example of mounting of the deodorizing apparatus 1, in which a seat 21 is formed in the same manner as in the above example shown in Fig. 2, and a pivot shaft 27 of the seat 21 is in communication with the cavity portion 23. The pivot shaft 27 is provided for supporting the seat 21 so that the seat can be opened and closed with respect to the toilet bowl 20. It has openings at both ends thereof, which are fitted in a communication pipe 28 through packings 27b. The communication pipe 28 is formed integrally while being bent at right angles, to which bent portion is connected the intake port 3 of the deodorizing apparatus as shown in Fig. 5. Therefore, the air in the toilet bowl 20 is introduced into the deodorizing apparatus 1 through the opening portion 29 of the seat 21, cavity portion 23, pivot shaft 27, communication pipe 28 and intake port 3, as indicated by arrows.

Fig. 6 shows an example of application to another shape of a toilet bowl, in which, above a

toilet bowl 20a with an opening formed in a stepped floor surface, there is disposed a removable, hollow stool 30 so as to cover the toilet bowl 20a. On the hollow stool 30 is formed a seat 21 and the deodorizing apparatus 1 is attached directly to the seat 21. Also in this application example, like the example of Fig. 2, the intake port 3 and the interior of the hollow stool 30 are communicated with each other. Fig. 7 shows a portable toilet bowl (a temporary toilet bowl for indoor use) 20b, in which window holes communicating with an inner bowl 35 are formed in the lower portion of the seat 21 and an annular cavity 23a is formed behind the window holes 31 so as to be connected to the window holes, with the intake portion 3 of the deodorizing apparatus 1 being connected to part of the cavity 23a. The air in the inner bowl 35 is introduced into the deodorizing apparatus 1 through the window holes 31, cavity 23a and intake port 3. Further, Fig. 8 shows an application example of the present invention to a hollow stool 30 disposed above a toilet bowl 20a which is provided on the floor surface. On the bottom side of a seat 21 there is formed an annular cavity 23a, and an opening portion 29a is formed downwards of the cavity 23a so as to face the interior of the hollow stool 30. Further, the intake portion 3 of the deodorizing apparatus 1 is communicated with the cavity 23a, which apparatus is disposed integrally with the hollow stool 30.

Fig. 9 shows a further example of mounting of the deodorizing apparatus 1, which is disposed on the floor surface through legs 14. In the side face of a seat 21 having the same structure as in the example of Fig. 2 there is formed a joint portion 36 which is in communication with a cavity portion 23, and a hollow pipe 13 is connected to both the intake port 3 of the deodorizing apparatus 1 and the point portion 36. Therefore, the air in the toilet bowl 20 passes through the opening portion 29, cavity portion 23, joint portion 36, hollow pipe 13 and intake port 3 and is introduced into the deodorizing apparatus 1. It is desirable that the hollow pipe 13 be formed using a bendable material having soft elasticity or formed bellows-like.

Fig. 11 shows a deodorizing apparatus 1 which is easy to be attached to and detached from a toilet bowl 20. To an intake port 3 of the deodorizing apparatus 1 is bonded a hook-like hollow pipe 13. The pipe 13 is formed of hard material (e.g. a rigid plastic or a metallic material) having a strength sufficient to support the whole of the deodorizing apparatus, and packings 17 having soft elasticity are attached to the concave portion of the hook-like hollow pipe. A distal end 13a of the hollow pipe 13 is disposed so as to face the interior of the toilet bowl 20, preferably in a position not impeding the opening and closing of the seat 21 nor impeding the sitting and leaving of the person in the toilet room, for example, a side part of the toilet bowl 20, as shown in Fig. 10. The numeral 16 in Fig. 11 denotes a supporter used to assist supporting and fixing the deodorizing apparatus 1. The supporter 16 is provided where required. As shown in this figure, moreover, if a casing 2 is provided with a cover 15 capable of being opened and closed, it will become easier to replace the catalyst bed 8 or the adsorbent layer 9 with a new one.

Fig. 12 shows a still further example of mounting of the deodorizing apparatus 1, which is disposed on top of a flush tank 31. The flush tank 31 is connected to a toilet bowl 20 through a water pipe 33 and also connected thereto through an overflow line 32 for the drainage of surplus water in the flush tank. Therefore, if an upper space 31a of the flush tank 31 and the intake port 3 of the deodorizing apparatus 1 are communicated with each other, the interior of the toilet bowl 20 and the deodorizing apparatus 1 are brought into communication with each other through the overflow line 32, whereby the air in the toilet bowl 20 can be fed to the deodorizing apparatus 1 as indicated by arrows.

Examples of mounting of the deodorizing apparatus 1 have been shown above with reference to Figs. 2 to 12. An explanation will now be given about controlling ON/OFF operation of the deodorizing apparatus 1 with reference to Figs. 13 to 16. The duration required for deodorization in a flush toilet is from the time when a person sits on the seat until when the offensive odor source is washed out and residual offensive odor components are treated completely, as previously noted. Therefore, it is recommended to use the control mechanism 12 for operating the deodorizing apparatus for only a required time without waste. The control mechanism 12 is disposed inside or outside the deodorizing apparatus 1, and a sensor 40 attached to the seat 21 and the control mechanism 12 are interconnected electrically or optically. An example of the sensor 40 is composed of a light emitting element 40a and a light sensing element 40b, as shown in Fig. 16. The sensor 40 is a reflection type sensor adapted to emit light upwardly of the seat 21. The emitted light beam is set at a length longer than the distance at which the sitter with the hip rising slightly (several centimeters) from the seat 21 is irradiated and shorter than the distance to the outer edge of the seat 21.

The sensor 40 is constructed so that the level at which the light emitted from the light emitting element 40a is reflected by the sitter and sensed by the light sensing element 40b, is detected by a sensed light level detecting circuit and the output of the detecting circuit is delivered to the control mechanism 12. Although in this embodiment the

sensor 40 is attached to the seat 21, it may be mounted to another portion, e.g. the toilet bowl 20.

The control mechanism 12 is connected to both the deodorizing mechanism 1a and a solenoid valve 34 in the flush water supply system of the toilet bowl. When the control mechanism 12 receives from the sensor 40 a detected signal indicative of the presence of a sitter on the seat 21, it provides an output signal to the deodorizing mechanism 1a. Further, when it is detected by the sensor 40 that the sitter is no longer recognized, the control mechanism 12 provides an output signal to the solenoid valve 34 and at the same time continues to provide output signals to the deodorizing mechanism 1a only for a certain preset time under the operation of a timer. In the control mechanism 12, the timer is set to a time during which the drainage by the solenoid valve 34 is completed and after the lapse of a certain time the deodorizing mechanism 1a stops operation. In order that the person next entering the toilet room may not smell an offensive odor, the timer set time is at least 1 minute, preferably 3 to 15 minutes.

Fig. 15 is a flowchart showing an example of operation of the deodorizing mechanism 1a and the solenoid valve 34 by the sensor 40, in which the above ON/OFF controlling operations are shown successively.

The sensor 40 comprising the light emitting element 40a and the light sensing element 40b is preferably of the type in which it is attached to the upper surface of the toilet bowl 20 or to the seat 21 to detect whether the thigh of a person is on the seat 21 or not. As previously noted, however, the sensor 40 may be of another type in which it is mounted in any position such as, for example, the flush tank 31 or the wall surface of the toilet room to detect a person entering or leaving the toilet room. Further, in place of the sensor 40 there may be used a seat pressure sensor 41 attached to the seat 21 to detect sitting or leaving of a person. There also may be used an infrared sensor or a limit switch as means for detecting sitting and leaving of a person. The mounting position of the deodorizing apparatus 1 is not limited to that shown in Fig. 13. The apparatus 1 may be disposed on the floor surface if only the sensor (40 or 41) and the solenoid valve 34 for the supply of water are connected electrically or optically to the control mechanism 12 disposed within the deodorizing apparatus 1. This is also applicable to the deodorizing apparatus 1 mounted as shown in Figs. 4, 8 and 11.

The provision of such control mechanism affords the following advantages. Firstly, the deodorizing treatment can be continued from the time when a person sits on the seat until when a certain time is elapsed after leaving, and during the deodorizing treatment the offensive odor source can be washed out by automatic drainage; further, the remaining offensive odor after use can be eliminated completely. Consequently, the deodorization can be completed before the next person enters the toilet room.

<Experiment Example>

Using the deodorizing apparatus of the structure shown in Figs. 1 and 2, a deodorizing experiment was conducted under the following conditions and the presence or absence of an offensive odor was checked by forty-five panel members. As a result, none of the panel members smelled an offensive odor:

Concentration of ozone generated: 0.5 ppm
Volume of sucked air: 17 times the internal volume of the toilet bowl (20) [per minute]
Catalyst bed: Honeycomb cell (210 cells per square inch)
Specific surface area 120 m^2/g
Contact area 0.035 m^2 (per air volume 1 m^3/hr)
Operation time: Start upon sitting and stop upon lapse of 7 minutes after leaving.

By adopting the above deodorizing method and apparatus:

① The volume of air sucked from the toilet bowl is appropriate and there is no diffusion or leakage of an offensive odor into the toilet room nor is there a great drop of the body feeling temperature during use.

② The concentration of ozone generated in the deodorizing apparatus is appropriate and there is no deficiency in deodorization or waste caused by the disposal of surplus ozone, nor is there leakage thereof from the deodorizing apparatus.

③ The amount of catalyst can be decreased so it is possible to attain the reduction in size of the deodorizing apparatus.

④ Since it is not necessary to use an ozone generator and a catalyst bed of larger capacities than required, a satisfactory deodorization effect can be expected over a long period, in addition to economic merits.

⑤ Since the deodorizing apparatus is operated only for a predetermined time, there is no waste of energy consumed and the deodorizing treatment can be done efficiently.

⑥ Since undecomposed offensive odor components can be adsorbed in the catalyst bed and thereafter subjected to the deodorizing treatment, it is possible to reduce the concentration of ozone generated and an ozone generator of a smaller capacity is employable. These are effective in attaining the reduction in size of the apparatus.

⑦ Although there is a fear that acids will be discharged in an undecomposed state, the provision of the adsorbent layer permits positive adsorption and removal thereof, so a more excellent deodorizing performance can be exhibited.

Claims

1. A method for deodorizing a toilet room, comprising sucking offensive odor components generated in a toilet bowl into a deodorizing apparatus together with the air in the toilet bowl at an air volume of 7 to 35 times the internal volume of the toilet bowl per minute, then mixing them with ozone to adjust the ozone concentration to a value in the range of 0.05 to 2 ppm, and passing the mixture through a catalyst bed to oxidize and decompose said offensive odor components.

2. A method for deodorizing a toilet room according to Claim 1, wherein the suction of the air and the offensive odor components is started when a person sits on the toilet bowl.

3. A method for deodorizing a toilet room according to Claim 1 or 2, wherein the deodorization is continued for not shorter than one minute after a person in the toilet room has left the toilet bowl and thereafter the suction is stopped.

4. A method for deodorizing a toilet room according to Claims 1 to 3, wherein undecomposed offensive odor components which have passed through said catalyst bed are adsorbed and removed in an adsorbent layer provided on a downstream side of the catalyst bed.

5. A method for deodorizing a toilet room according to Claims 1 to 4, wherein the offensive odor components which have been adsorbed by part of said catalyst bed are decomposed with surplus ozone which is supplied subsequently.

6. An apparatus for deodorizing a toilet room by decomposing offensive odor components using ozone, wherein an air passage providing communication between an intake port and an exhaust port is formed, said intake port being in communication with the interior of a toilet bowl; an ozone generator is provided within said air passage on said intake port side; on a downstream side of said ozone generator there are formed a mixing chamber for mixing offensive odor components and ozone together as well as a catalyst bed contiguous to said mixing chamber to decompose the offensive odor components and unreacted ozone; a fan for forming a current of air is disposed in a suitable position within said air passage, said components being received in a casing by opening said intake and exhaust ports; and there is further provided a control mechanism for controlling ON/OFF operation of said fan and ozone generator.

7. An apparatus for deodorizing a toilet room according to Claim 6, wherein a seat having an opening portion on the bottom side thereof is disposed above the toilet bowl while a gap is formed between the bottom of said seat and the upper surface of the toilet bowl, said opening portion extending along part or the whole of the upper edge of the toilet bowl, and a side edge portion of the toilet bowl is in communication with said intake port.

8. An apparatus for deodorizing a toilet room according to Claim 6, wherein a seat having an opening portion on the bottom side thereof is disposed above the toilet bowl while a gap is formed between the bottom of said seat and the upper surface of the toilet bowl, said opening portion extending along part or the whole of the upper edge of the toilet bowl, said seat being mounted to the toilet bowl through a hollow pivot shaft so that it can be opened and closed, and said hollow pivot shaft being in communication with said intake port.

9. An apparatus for deodorizing a toilet room according to Claims 6 to 8, wherein a hollow pipe is connected at one end thereof to said intake port, the opposite end thereof facing the interior of the toilet bowl.

10. An apparatus for deodorizing a toilet room according to Claim 9, wherein said hollow pipe is formed in the shape of a hook using a hard material, and the whole of the casing is supported by bringing said hook-like hollow pipe into engagement with the upper edge of the toilet bowl.

11. An apparatus for deodorizing a toilet room according to Claim 9, wherein the opposite end of said hollow pipe is connected to the seat and faces the interior of the toilet bowl through the seat.

12. An apparatus for deodorizing a toilet room according to Claims 6 to 11, wherein an overflow line is provided in a flush tank communicating with the interior of the toilet bowl, said overflow line providing communication between the interior of the toilet bowl and an upper space of said flush tank, said upper space of the flush tank being in communication with said intake port.

13. An apparatus for deodorizing a toilet room according to Claims 6 to 12, wherein in said control mechanism there are provided a light emitting element for emitting light upwardly of the seat and a light sensing element for sensing light reflected from a human body; at least said fan and ozone generator in the deodorizing apparatus are operated when said light sensing element senses the reflected light; and a timer is connected to said light sensing element to stop the operation of at

least said fan and ozone generator upon lapse of a certain time after extinguishment of the reflected light.

14. An apparatus for deodorizing a toilet room according to Claim 13, including a sensor comprising a light emitting element which emits light toward the legs of a person who sits on the toilet bowl and a light sensing element which senses light reflected from said legs.

15. An apparatus for deodorizing a toilet room according to Claims 6 to 12, wherein a seat pressure sensor is attached to the upper surface of the toilet bowl or to the seat to operate at least said fan and ozone generator in the deodorizing apparatus when a person sits on the seat, and a timer is connected to said seat pressure sensor to stop the operation of at least said fan and ozone generator upon lapse of a certain time after the person has left the seat.

16. An apparatus for deodorizing a toilet room according to claim 13 or 14, wherein a solenoid valve for the flush of wash water is connected to said light sensing element through said control mechanism, said solenoid valve being opened after the person has left the seat.

17. An apparatus for deodorizing a toilet room according to Claim 15, wherein a solenoid valve for the flush of wash water is connected to said seat pressure sensor through said control mechanism, said solenoid valve being opened after the person has left the seat.

18. An apparatus for deodorizing a toilet room according to Claims 6 to 17, wherein an adsorbent layer for adsorbing undecomposed offensive odor components is provided on the exhaust port side of said catalyst bed.

19. An apparatus for deodorizing a toilet room according to Claims 6 to 18, wherein said catalyst bed is formed by honeycomb cells.

20. An apparatus for deodorizing a toilet room according to Claim 19, wherein the number of said honeycomb cells is 100 to 400 cells per square inch, and said catalyst has a specific surface area not smaller than 50 m^2/g and a contact area in the range of 0.01 to 0.35 m^2 per an air volume of 1 m^3/hr.

Fig. 1

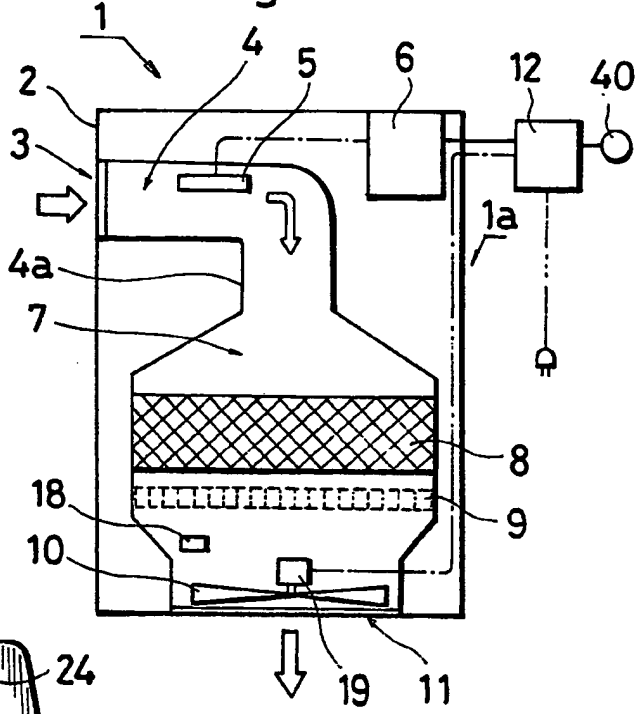


Fig. 2

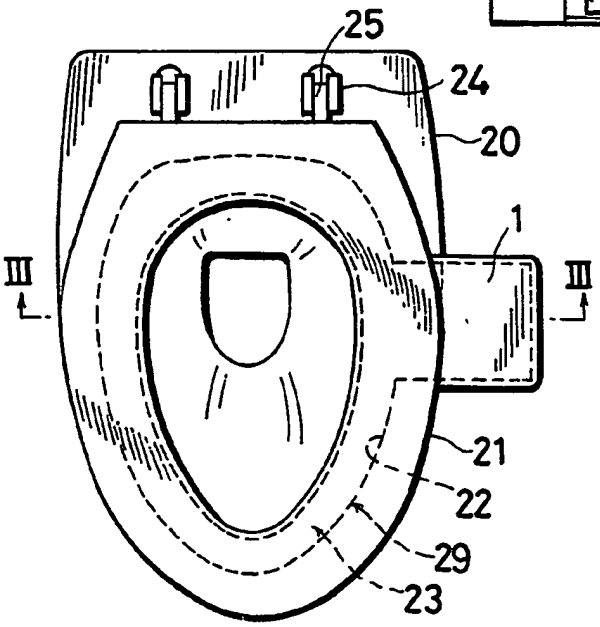


Fig. 3

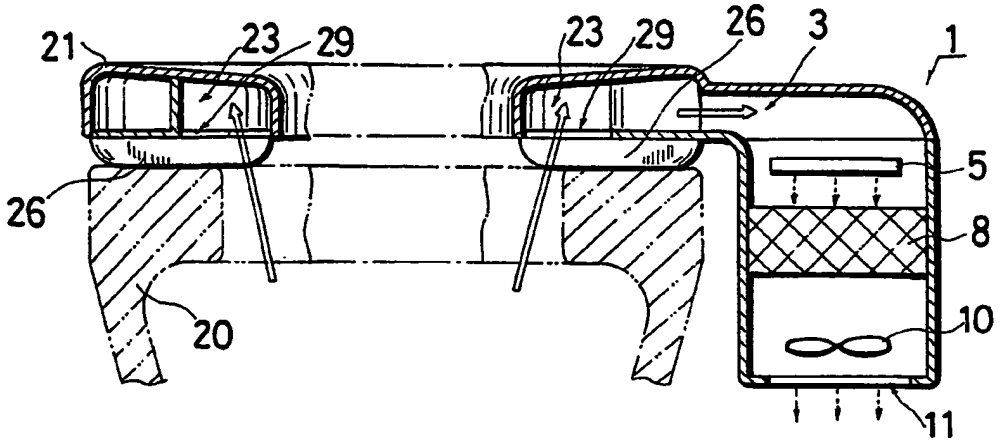


Fig. 4

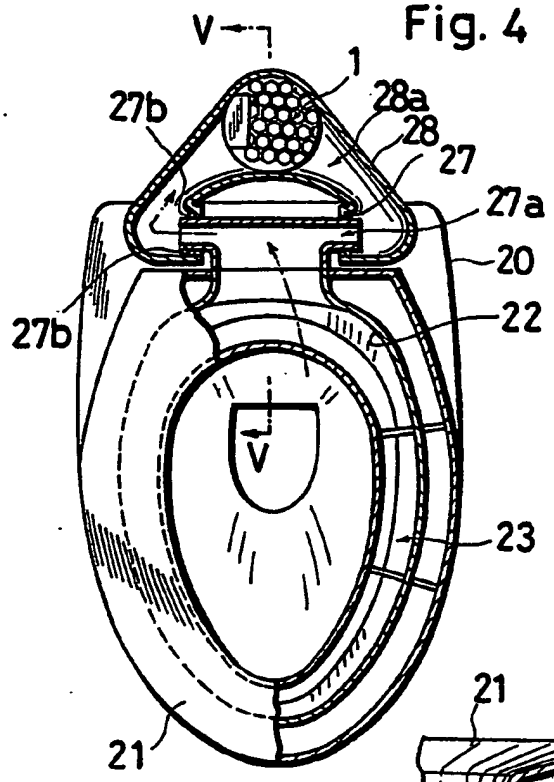


Fig. 5

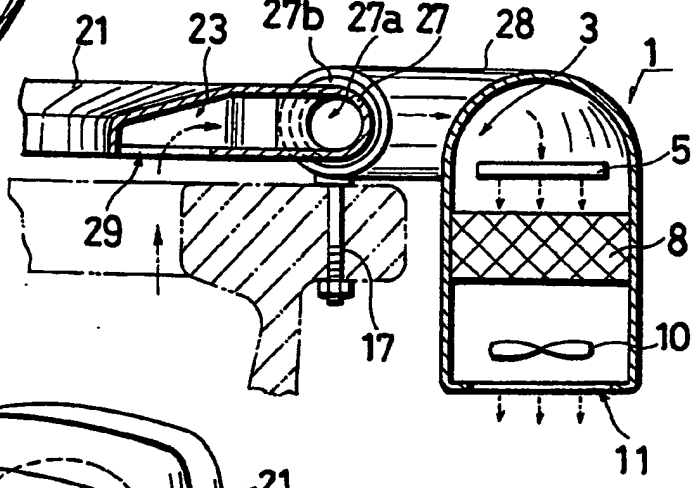


Fig. 6

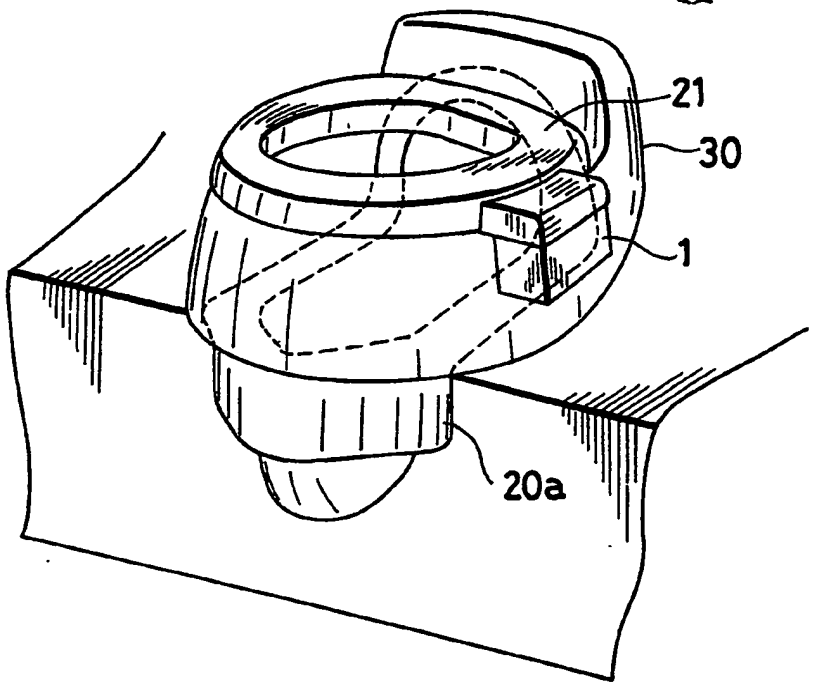


Fig. 7

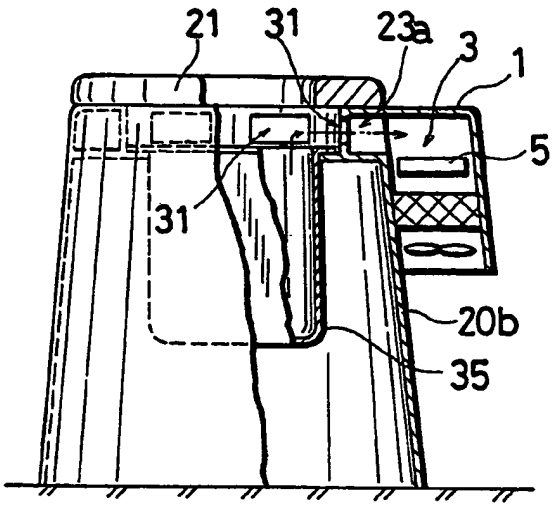


Fig. 8

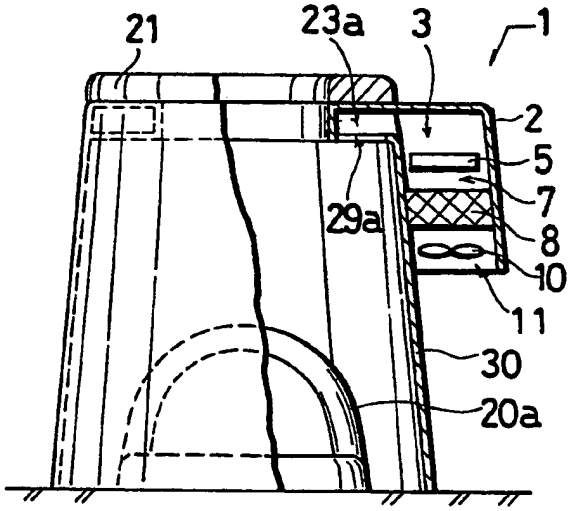


Fig. 9

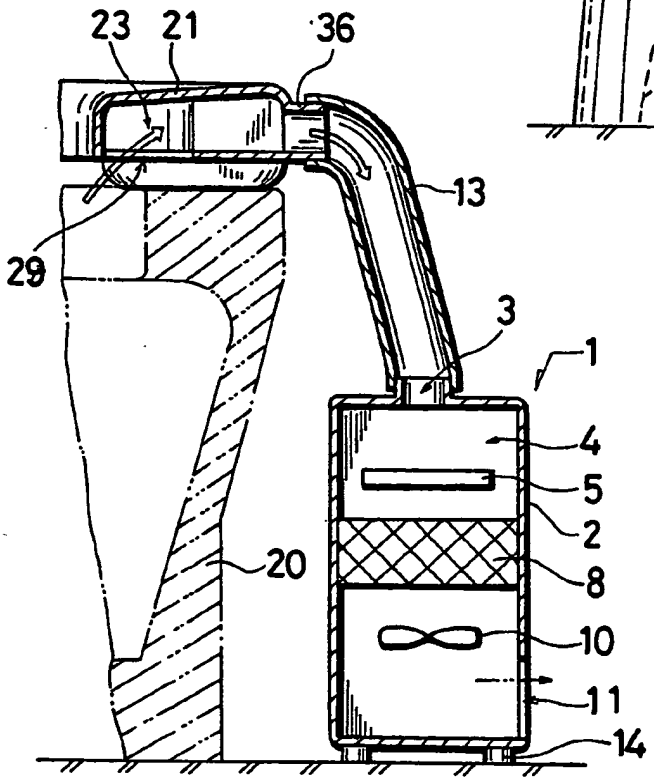


Fig. 10

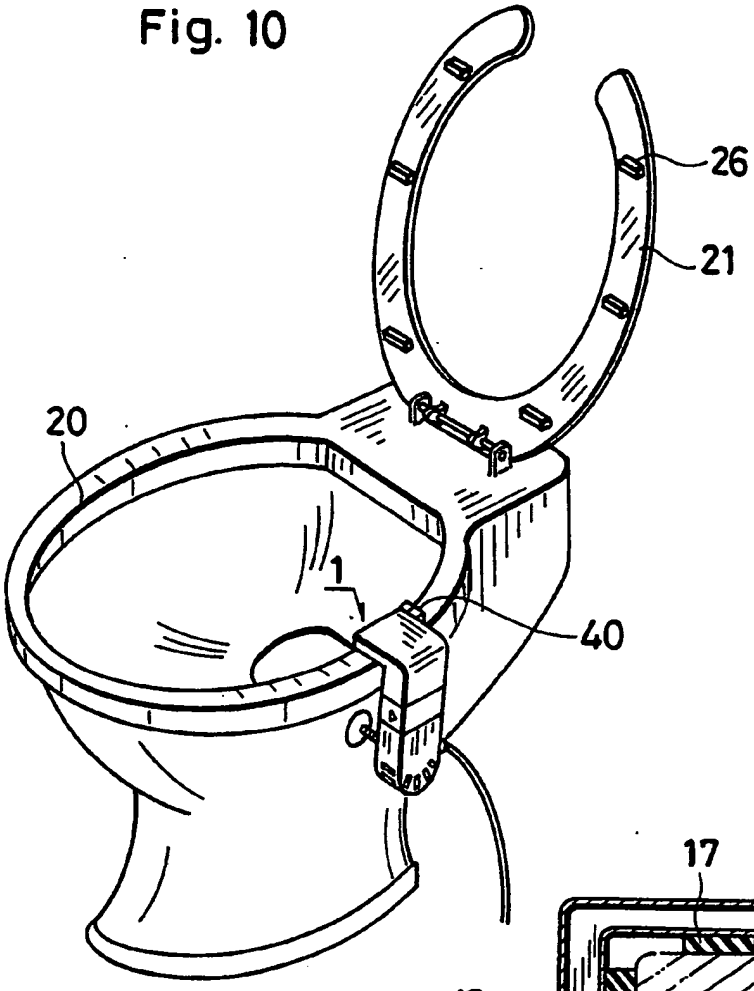


Fig. 11

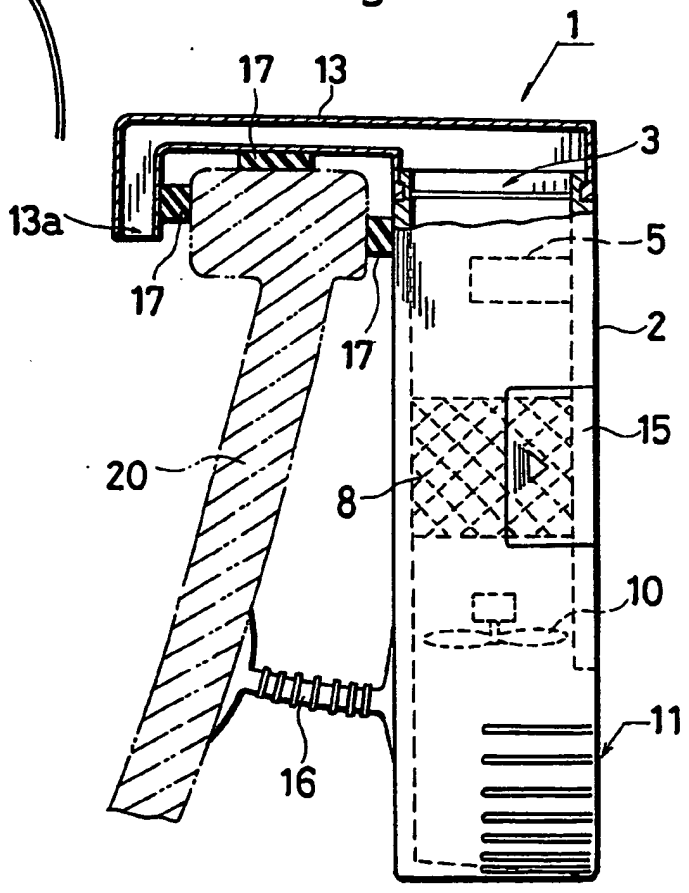


Fig. 12

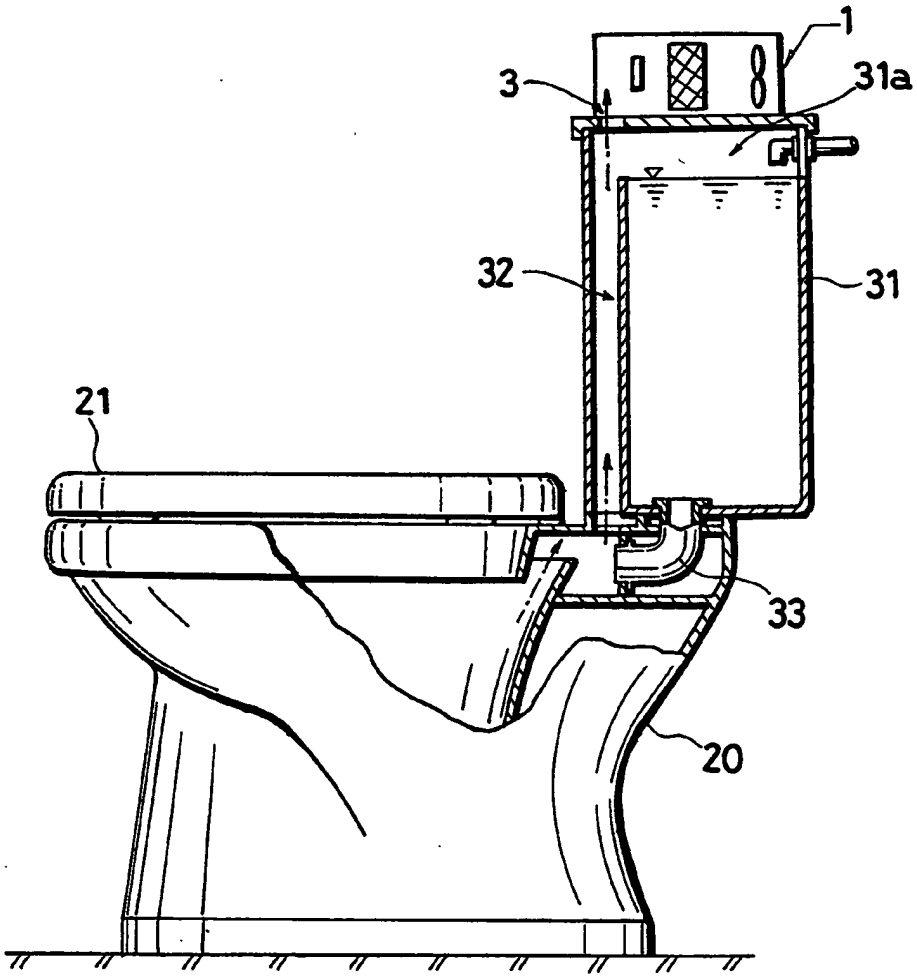


Fig. 13

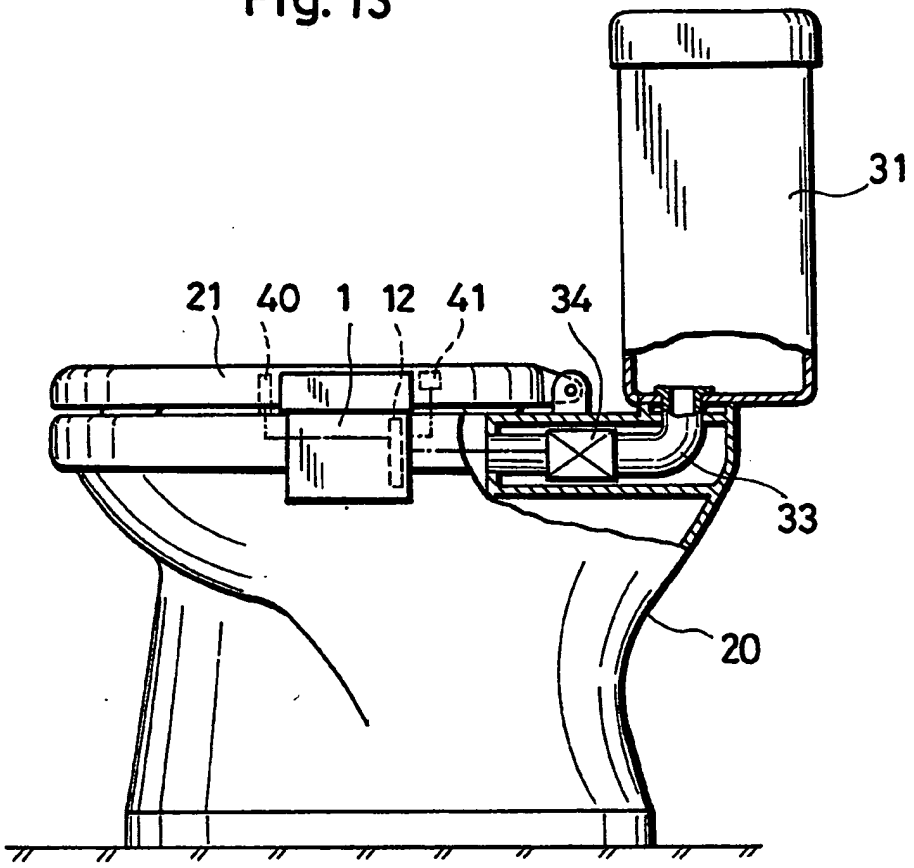


Fig. 14

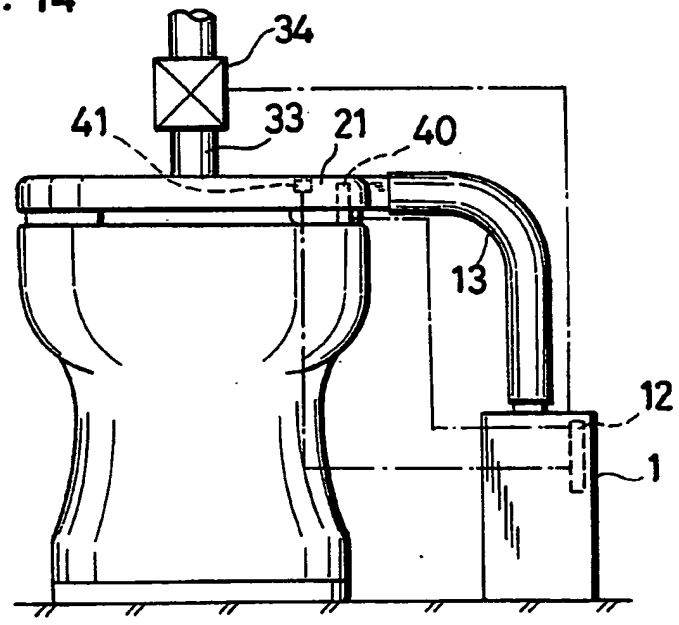


Fig. 15

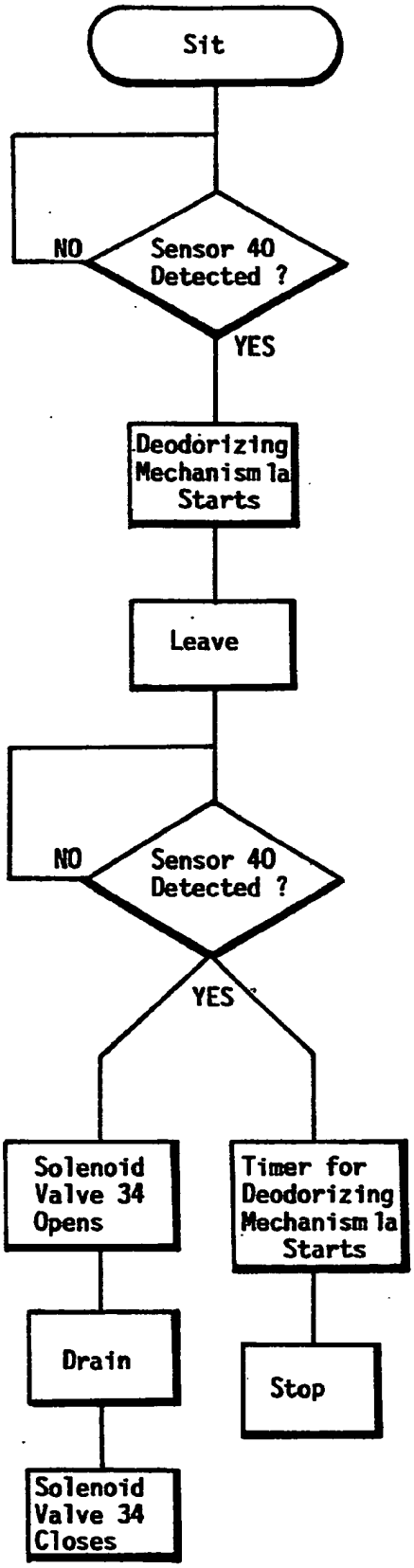
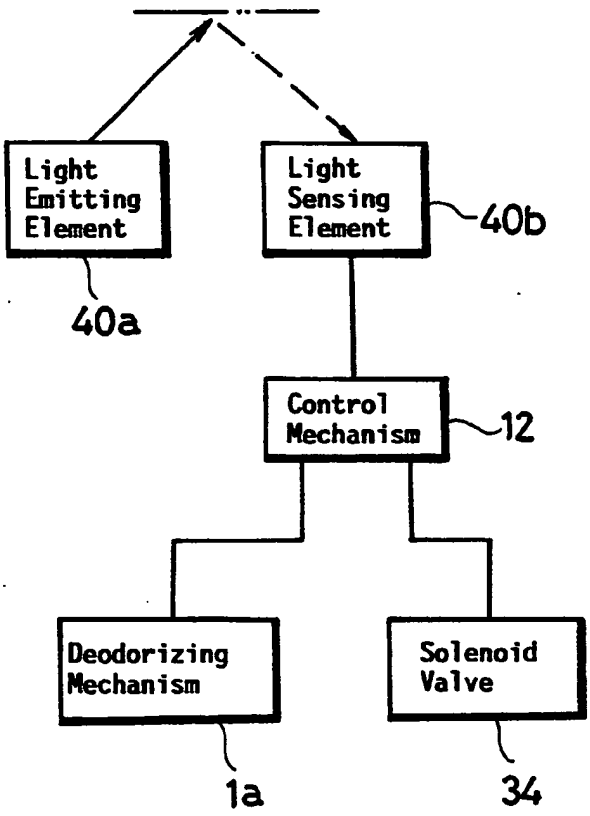

Sit
NO
Sensor 40 Detected ?
YES
Deodorizing Mechanism 1a Starts
Leave
NO
Sensor 40 Detected ?
YES
Solenoid Valve 34 Opens
Timer for Deodorizing Mechanism 1a Starts
Drain
Stop
Solenoid Valve 34 Closes

Fig. 16


Light Emitting Element
40a
Light Sensing Element
40b
Control Mechanism
12
Deodorizing Mechanism
1a
Solenoid Valve
34

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 10 3776

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-2 001 592 (M.O. TEETOR) * Page 1, right-hand column, line 36 - page 2, left-hand column, line 73; claim 1; figure 1 *	1,6	E 03 D 9/052
A	US-A-4 251 888 (W.F. TURNER) * Figures 3,4; column 2, lines 41-68 *	2,3,6,7,15	
A	GB-A-2 143 872 (J.H. BILLING) * Figures 1-3; page 1, lines 102-120 *	7,8	
A	US-A-2 009 054 (B.A. MOONEY) * Whole document *	9-11	
A	US-A-4 044 408 (R.H. PEARSON) * Figures 1,4; column 2, lines 61-67; column 3, lines 13-15 *	4,12,18	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 03 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28-04-1989	BIRD, C.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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